Air-Sea Interaction Simulation Facility for Research, Teaching and Instrument Development

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LONG-TERM GOAL

To provide a modern air-sea interaction simulation facility with salt water and high wind speed capability to: enable a wide range of research in remote sensing, gas transfer, surface chemistry, spray and aerosol generation, turbulence and wave dynamics; to enhance and enliven the teaching of processes at and near the air-water interface and the technology and methodology of measurement and analysis of thereof; to provide a versatile test-bed for the development, testing and calibration of instruments.

APPROACH

We propose to build a medium size wind-water tunnel with a working section of 1 m x 1 m x 15 m (Figure 1). The school has allocated the necessary space for the facility (overall length 24 m) and associated space for physics, chemistry and computing laboratories. The tunnel/tank and associated

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return ducting and piping will be made of acrylic or stainless steel to minimize corrosion and chemical contamination of trace species. The facility is designed to use sea water or fresh water as desired and the location chosen is already supplied with storage tanks and pumping systems for both sea water and fresh water.

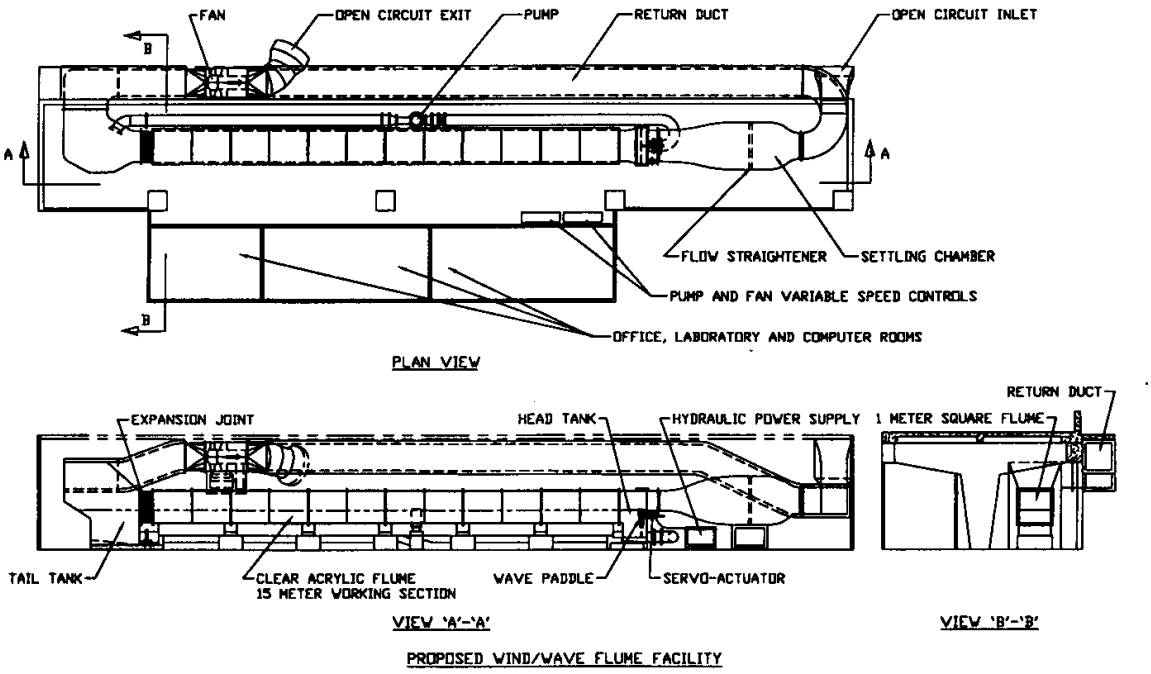

Figure 1. Schematic drawing of the air-sea interaction, salt-water tank (ASIST) facility.

A large heat pump will be provided to allow us to maintain water temperatures between 0^{o}C and 40 ^{o}C, which will allow us to explore temperature effects on the physical and chemical aspects of gas transfer. The air and water flows will be driven by a 40 hp variable fan and pump respectively. This will allow tests to be done at high wind speeds (30 m/s at centerline of the tunnel -- equivalent to hurricane speeds) and also substantial water speeds (0 to 35 cm/s) permitting tests of the effect of water turbulence on gas transfer.

The wind tunnel is designed to operate in two modes: `recirculating' and `venting'. This flexibility makes it possible to do both recirculation experiments of evasion and invasion, in which the equilibration of a closed system provides an integrated measure of gas transfer -- leading to great precision, or venting experiments (generally for evasion), in which a large concentration difference can be maintained for extended periods.

The return air duct is displaced laterally rather than directly above the working section. This will permit the maximum access to viewing the surface from above for remote sensing experiments and to introducing profiling *in situ* probes. Each 2.5 m segment of the working section is to be constructed in two parts: 1) the bottom and sides are to be of a single piece; 2) the top will be a removable slab. This offers maximum access to the tank for cleaning and allows complete flexibility in the choice of water depth between 0 and 1 m. The return air will run outside the building in a well insulated duct. This both optimizes the use of valuable inner building space and simplifies the periodic duct cleaning.

The Air-Sea Interaction Facility will have the following characteristics:

1. acrylic and stainless steel construction.
2. sea water or fresh water and all mixtures.
3. controlled water temperature 0 ^{o}C to 40 ^{o}C.
4. wind speeds of 0 - 30 m/s.
5. water speeds of 0 - 35 cm/s in either direction.
6. programmable wave-maker -- hydraulically driven paddle.
7. recirculating or venting modes of operation.
8. attached chemistry laboratory, instrument laboratory and data collecting and computing room.

WORK COMPLETED

The wind-wave tank facility has been designed (see Figure 1) and several components have been ordered. The area of the ground floor of the Glassell building, which has been allocated for the installation of the facility, has been cleared of its previous occupants and the walls and ceiling have been cleaned and repainted. The installation will begin in late November, while the purchase of measurement and data acquisition systems will begin in December.

RESULTS

None yet.

IMPACT/APPLICATION

This salt-water capable air-sea interaction facility will be used for research, teaching, and for instrument testing, calibration, and development. The facility will be unique in its capacity to simulate air-sea interaction over a wide range of environmental conditions using both seawater and fresh water. This facility will be used by a number of ongoing research programs investigating the remote sensing of surface ocean wind/wave fields, turbulent kinetic energy dissipation in near surface waters, buoy technology development for high resolution wave and flux measurements, skin temperature effects on remote sensing, and air-sea exchange of gases and aerosols. The facility will also be incorporated into educational programs at the University of Miami in applied marine physics, physical oceanography, and marine and atmospheric chemistry.

TRANSITIONS

None yet.

RELATED PROJECTS

The air-sea interaction, salt-water tank (ASIST) facility will be a necessary adjunct to many field programs such as the Shoaling Waves Experiment (SHOWEX). The ability to control the external forcing to interfacial processes will be of enormous help in elucidating the role of such processes in air-sea interaction and remote sensing.